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Getting Ready for Driverless Cars

By Donald L. Elliott, FAICP

News about driverless cars is everywhere. It seems that everybody wants in on this “next best thing.” Apple is playing. So is Google. So is Tesla. Even the U.S. military (though you won’t be inside one of those unless you enlist).

Of course, not everyone is happy about this prospect. Some are fearful that the brains behind the vehicles might not be as smart as we hope; others swear they love driving too much to stop. But others yearn for the day they can drink coffee and read a novel while the car takes them where they want to go.

Unfortunately, much of the media coverage seems to focus on impressing us with this emerging technology, but provides little information about how the technology is likely to arrive and what changes we will see first. More specifically, the media blitz has left many planners wondering just what they should be doing to prepare for this brave new world. To help answer that question, let’s focus on some basic facts about driverless cars, likely scenarios for their arrival,

and what impacts planners are likely to see sooner rather than later.

One caveat at the start. This article assumes that driverless cars are coming whether we like them or not. While cities and counties will probably retain many powers to regulate their use—and will use those powers as their elected officials see fit—I assume that neither federal nor state nor local governments will significantly restrict their introduction into our vehicle fleet. This article is not about whether we should have driverless cars, but how to prepare for their arrival (To dig deeper, visit APA’s resource for planners. *Autonomous Vehicles: Planning for Impacts on Cities and Regions* is at planning.org/research/av.)

THE BASICS

To begin with, we’ll call them “autonomous vehicles,” or “AVs,” which seems to be the emerging preferred term. Three key facts about AVs need to be kept in mind as we think about how to plan for them.

First, AVs Are Not One ‘Thing’

The Society of Automotive Engineers lists the following five categories of AVs (sae.org/autodrive):

1. Driver Assistance (like cruise control)
2. Partial Automation (like adaptive cruise control that brakes on its own)
3. Conditional Automation (system monitors the area and drives but may need help on demand)
4. High Automation (system monitors the area and drives in some conditions)
5. Full Automation (system can drive in all conditions without help)

At levels one and two, the driver is responsible for monitoring everything going on around the car (other cars, pedestrians, road conditions, weather)—so no reading a novel. At levels three and four, the car is monitoring what is going on nearby, and can drive part of the time, but may need help or need to have the human take over in some situations (like bad weather). So probably no reading a novel, because you don’t know when the AV will ask for you to respond to a situation. We really haven’t seen level five AVs yet (for example, many still have trouble in severe weather conditions). That means *The Jetsons* vision of a car that takes you where you want to go without any effort on your part is still a way off in the future. Most news coverage that “X will introduce a driverless car by 2020” doesn’t clarify what level of AV will be introduced. Any changes in commuting patterns or choices of where to live will depend heavily on how much work the human still has to do (or be prepared to do).

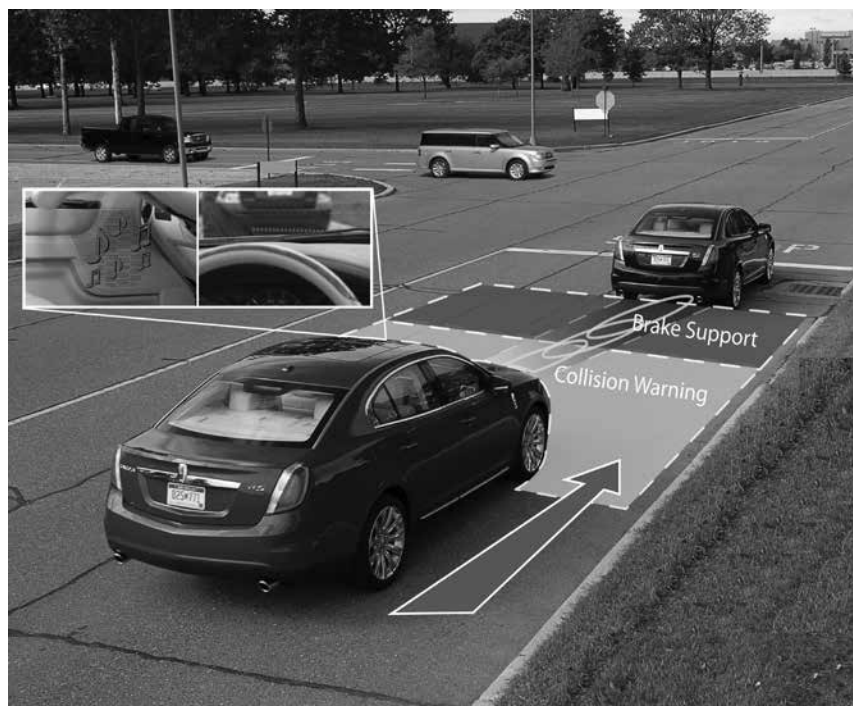
Second, AVs Are Not Coming All at Once

Yes, AV technology has improved fast, and some automakers now say they will begin to introduce AVs by sometime between 2018 and 2021. By some estimates, AVs may capture 15 percent of the market by 2030, and maybe 50 percent of the market by 2040. That’s pretty fast. While the projections do not say so, we’ll assume that they are all level-five AVs—they can drive for you all the



Diablanco, Wikimedia (CC BY-SA 3.0)

➡ An Uber self-driving car on a test drive in downtown San Francisco.



Ford Motor Company, Flickr (CC BY-NC 2.0)

Partial automation features such as dynamic brake support and crash-imminent braking have been available in the U.S. for more than a decade, and major automakers have committed to installing automatic emergency braking systems in all new cars by 2022.

time. On the other hand, the U.S. currently has 264 million non-AV cars. So even if 50 percent are AVs by 2040, there will still be 132 million non-AV cars on the road. To make things more complicated, those cars will vary between AV levels one and four. They will have a range of capabilities.

For planners, this is a key fact. It means that for the foreseeable future we will be planning for cities, streets, and mobility for a mixed AV/non-AV system. (See “Here Come the Robot Cars,” *Planning*, April 2017: planning.org/planning/2017/apr/robotcars.) For the rest of many of our professional careers, we will need to identify and respond to the different housing, working, and mobility needs of our citizens who use AVs while also responding to the needs of those who don’t. Streets will be shared by cars with and without drivers (not to mention bikes and pedestrians); parking garages will probably not go the way of the dinosaur; and housing markets will continue to reflect the needs of those who want to live close to work and those who don’t. This AV/non-AV mix will

no doubt foster lots of innovative products and services, but it also carries the seeds of long-term conflicts that will need to be resolved. This key point may be the most important one for planners—but it is one that is rarely discussed in the news.

Third, a Lot Depends on Who Owns the AVs

There are two common visions about how AVs will operate. In the first vision, ride service firms will make fleets of AVs available to people needing mobility and will perfect and operate software that optimizes the efficiency of the fleet so that a subscriber’s wait and trip will be as short as possible. This would be a super-efficient system that decreases the need for individual car ownership, shortens trip lengths (and greenhouse gases), reduces the need for parking spaces (because the cars are moving about most of the time), and reduces the “waste” of today’s cars sitting still while we work or shop or play.

The second vision is one of private individual ownership; a vision where I will

trade in my non-AV car for an AV that will provide individual services to me. It will be just like my current car except I don’t need to drive it, and it knows when it could take my significant other somewhere and get back before I need it again—potentially allowing me to own fewer vehicles. In this vision, I still commute to work, so my AV occupies street space (just like my non-AV used to do). When there are no other family members to serve, it also sits still somewhere (just like my non-AV used to do). When the AV is not shared with a big group of people that need it in different places and times, the opportunities for a more efficient transportation system are reduced. It’s sort of like today’s world; I just don’t have to drive.

Since we live in the U.S.—a country that prides itself on allowing individual freedom—it is very unlikely that any level of government will prohibit private ownership of AVs for individual use. In fact, in September 2017 the U.S. government relayed the Trump administration’s goal to take a hands-off approach to regulation of AVs with the release of *Automated Driving Systems 2.0: A Vision for Safety*. So not only will we have a mix of AV and non-AV cars on the road, we will have a mix of system-operated AVs operating on software designed to maximize their efficiency (or profitability) and individually owned AVs carrying out the unpredictable mix of commuting, shopping, errands, and pleasure trips that they do today.

While the first vision is more efficient, both raise concerns for planners. First, both visions could be tempting alternatives to public transit. Those who ride the bus for non-sustainability reasons (they don’t like to drive, they can’t drive, or they like to work while they commute) may decide that AVs offer them the same choices plus privacy. Lower public transit ridership creates financial pressures on transit systems and could mean that more transit riders are those with no other mobility options. Second, both visions may tend to feed sprawl. If I can work while I commute in a private vehicle, maybe I don’t hate commuting as much as I thought, so maybe I want to move further from my job. It wouldn’t take a big shift toward longer commutes to undo years of slow progress in trying to reduce vehicle miles travelled.

The point is that—despite the media hype—planners who make and implement

plans will be working in a very fluid environment in which a variety of AV and non-AV vehicles, operated both individually and by coordinated systems with different mobility patterns, are being introduced over a long period of time. And all this will be occurring while distributors, wholesalers, and retailers introduce AV over-the-road trucks, AV delivery trucks, and drone deliveries. The good news is that most of these changes will happen over the 20- to 30-year planning horizons of most comprehensive plans. All of the potential impacts of AVs will not show up at once, which allows us to focus on those impacts that are likely to occur sooner rather than later.

HOW WILL ZONING NEED TO ADAPT TO AVS?

Most land-use control systems are organized to address each of the following major topics, although the order and the priority they give to those topics varies a lot:

1. Parking and Access
2. Streetscape and the Public Realm
3. Permitted Building Forms and Dimensions
4. Permitted Land Uses

The potential impacts of AVs on each of these zoning topics is discussed below, with particular emphasis on which impacts are likely to appear in the short run. Let's start with parking, since much of what follows relates back to that topic.

Parking and Access

One estimate is that the U.S. currently has two billion parking spaces. That's almost six spaces for every man, woman, and child in the country. Or almost 10 spaces for every licensed driver. Think about that the next time you cannot find a parking space; there are 10 of them out there just waiting for you. Up to 75 or 80 percent of suburban commercial property area is sometimes-occupied parking. In urban areas, parking can occupy between 20 and 30 percent of building envelopes. If those numbers seem high, consider that the average size of a parking space (200 square feet, not counting driving aisles and access to the space) is two-thirds the size of some micro-unit dwellings (300 square feet, not counting hallways and lobbies and access to the unit). If AVs do result in decreased demand for on-site parking,

TYPE OF VEHICLE IN OPERATION	POTENTIAL REDUCTION IN PARKING DEMAND
A. AV owned and operated by a mobility sharing system like Uber or Lyft	Significant, because operation of the vehicles is optimized to keep them moving most of the time
B. AV owned individually but operated by a mobility sharing system when the individual's household does not need it (think timeshare or Airbnb for cars)	Less than type A, since efficiency will be reduced by the need of the vehicle to get to where the household needs it when they need it
C. AV owned and operated individually for household use	Less than type B, because the AV is parked whenever the household does not need it
D. Level 1–4 AVs that require driver involvement	Same as today

that could require major changes in zoning requirements for parking.

Whether AVs result in reduced demands for parking turns on the fleet ownership mix and the long time frame over which they will be introduced (see the table above).

The fleet mix will probably move from type D to C, and perhaps from types C to B and B to A over time as AV mobility systems improve, but for a long period, reductions in parking demand will occur gradually because of the mix of vehicles in use. If you work in a community that has no minimum parking requirements, rest easy, because there is every reason to believe the market will adjust the supply of parking as demand for parking changes. But most medium and large cities and counties still have minimum parking requirements (and are hesitant to repeal them altogether), so what does this mean for planners in those communities? It means that cities and counties should

- continue to monitor parking usage to see how fast this transition is occurring, and reduce any minimum parking requirements to reflect those trends;
- think about potential reuse of surface parking areas (e.g., for vertical development, stormwater infiltration areas, or additional open or recreational space) as demand for those spaces falls; and
- consider whether reductions in parking demand should result in increased lot coverage ratios.

In addition, planners should be thinking about the need for “staging areas” for AVs—particularly those operated by shared mobility systems—when those vehicles are

not in use. No matter how efficient the system, the supply and demand for AVs will not always align. Despite our amazing abilities to work from home, telecommute, and work over the internet, most large communities still experience rush hours when commuters want to get to and from work. It is unlikely that AVs will change that. Yes, some of those AVs will be used for nonwork trips between rush hours, but there are not as many of those trips to be made (otherwise we would not have rush hours since all the nonworkers would be making non-rush-hour trips and traffic volumes would not vary through the day). Yes, mobility systems will try to influence travel behavior by discounting rates at low demand times and raising them at other times, but I predict that we will still have variations in traffic levels throughout the day.

So where will the AVs hang out while waiting for their next optimized ride? In the short run, it is likely that they will use current parking lots as staging areas. And as parking demands fall, it will be rational for parking lot and garage operators to make space available to shared mobility systems and have parts of their lots or garages available for AV staging (for a price). When that does not happen, the AV system operators may need to construct lots or garages in optimized locations. But since it is hard to optimize locations when ride demand can come from anywhere (think of demands for Lyft and Uber today), it is more likely that the demand will be met by leasing or buying parts of current parking facilities in dispersed locations.

This means that reduced demand for parking space to park cars will be partially

offset in the short run by demands to use (or construct) them as staging areas. Planners should also think about their design standards for parking lots and garages, because when those facilities are used as staging areas, there may be a lot more in-and-out activity than in today's parking garages (where in-and-out activity tends to mirror peak traffic periods). That may mean more entrances and exits that disperse entry and exits onto more or different streets.

While there has been some media coverage of staging areas (mostly talking about how many more AVs can occupy spaces because they could be smaller vehicles that park within inches of each other and never make a mistake), there has been little coverage about how the need for staging areas will act as a partial brake on reduced demand for parking lots and garages. Planners who have not thought about demand for staging areas should think about the alternative. If AVs do not wait somewhere still during nondemand periods, they will need to move around, which will compound traffic congestion needlessly (cars moving around for no purpose) and degrade air quality (at least until the AVs are all electric and our national electric system doesn't burn fossil fuels). Surely that is a worse outcome than allowing staging areas.

Site Design

In addition to gradual changes in demand for parking, the introduction of a mixed fleet of AVs may have a fairly significant impact on site design. Just as Uber and Lyft can pick up and drop off customers exactly where they want, AVs operated by mobility systems will do the same—or they will try to. One of the earliest impacts of AVs may be increased demand for on-site drop-off and pick-up areas. Today, most zoning codes only require drop-off/pick-up areas for specific uses. At the top of that list are hotels, because the level of drop-off/pick-up activity is high. Somewhere near the top of the list are child care facilities, because we think young children probably should not be dropped off on the street if that can be avoided. Sometimes they are required for nursing care or elderly care facilities, on the assumption that our elderly also should be treated a little better than dropping them off on the street. Sometimes large facilities like hospitals, auditoriums, and educational facilities are included.

However, few zoning ordinances require drop-off/pick-up locations for office buildings, street-oriented retail, restaurants, multifamily residences, mixed use buildings, and the vast majority of other land uses. Today, most of that activity takes place on the street. The dramatic increase in drop-off/pick-up activity by systems like Lyft and Uber is already noticeable, and when we use those services we sometimes think “Hmm, where can I stand where the car can both see me and pull over to pick me up?”

It is unlikely that the dramatic increase in drop-off/pick-up activity that will accompany both system-owned and individually owned AVs can be accommodated within the street right-of-way (more about that later) without potentially significant impacts on traffic congestion and pedestrian safety. So planners should think about what types of additional facilities (or maybe just large ones) will be needed for drop-off/pick-up areas in the future. While they're at it, planners should think about how those areas can be designed to minimize conflicts with bicycle and pedestrian traffic.



Another Believer, Wikimedia (CC BY-SA 3.0)



A curbside drop-off/pick-up zone for on-demand ride services.

The Edge of the Street

While the introduction of AVs may have significant impacts on street design, most zoning ordinances do not deal directly with design of through-traffic lanes (or they share that turf with engineering manuals approved by the public works department). But zoning ordinances do frequently regulate streetscapes and the “public realm” between building frontages and the through traffic lanes (i.e., the edge of the street, where the demands of urban design meet the demands of traffic management). In addition to requiring additional *on-site* pick-up/drop-off areas, the introduction of AVs will increase demands for *on-street* drop-off/pick-up areas. In fact, the on-street impacts may be felt earlier, since drop-offs at existing buildings that do not have an on-site area will have to occur in the street. That may result in pressure to convert some of our current on-street parking spaces to drop-off/pick-up areas so that the AVs do not block traffic while on-boarding or off-loading humans.

In a perfect world, the demand for on-street parking spaces would fall exactly as much as the demand for on-street drop-off/pick-up areas rises, so the problem would solve itself. The city would just have to monitor the changing use and mark spaces or take out parking meters to reflect that changing demand. However, in the real world those miracle alignments of competing demands happen rarely, so planners should be thinking about how to accommodate increased on-street drop-offs and pickups.

All of this assumes that the issue arises on streets that currently provide on-street parking. If they occur on streets without on-street parking, then there may be pressure to create drop-off/pick-up areas out of areas currently occupied by trees, lawns, street furniture, patios, or other types of pedestrian-friendly urban amenities that many planners have been trying to promote. That may lead to prohibitions on AV drop-offs and pickups along some street segments.

In addition, planners should note the potential tension between the need for more on-street drop-offs and pickups and the goals of many complete streets programs. At the same time, we are trying to reinvent streets to allow more room for bicycles, pedestrians, and sometimes buffers between different modes of travel, so there



Dilu, Wikimedia (CC BY-SA 4.0)

➡ A small fleet of Volvo 780 semis converted into self-driving trucks by Uber subsidiary Otto, parked at the company's headquarters in San Francisco.

will be increased demand for edge-of-the-street drop-off and pick-up areas. That may require rethinking of some complete street designs or not allowing AV drop-offs or pick-ups on some street frontages.

Permitted Building Forms and Dimensions

In contrast to the potentially significant impacts on parking, staging, and street edges discussed above, the introduction of AVs may not have equally significant impacts on building forms and dimensions. The potential impacts include

- less building square footage devoted to in- or under-building parking garages;
- more ground floor building area devoted

to drop-off/pick-up areas; and

- in those communities that regulate density by floor-area ratio (FAR), more available FAR being used for business as opposed to parking uses, which could mean higher occupancy of the building, more commuting to and from the building, and a need to rethink what levels of FAR can be supported by the streets and public transit system.

In short, the introduction of AVs is unlikely to require significant redesign of the types of buildings demanded by the private sector in the short run. The changing demands for building form and design are more likely to be driven by macroeconomic

trends, such as declining demand for brick-and-mortar retail, significant unmet demands for affordable housing, declining space devoted to each office or back-office worker, rising demands for services for our aging population, and declining industrial employment throughout the U.S. While basic building forms may not change, however, there will be impacts on needed uses of buildings and land.

Permitted Land Uses

Since the U.S. building stock changes slowly over time—almost all the buildings that will exist 10 years from now are already here—many changes in land-use demand need to be accommodated within our existing land

and building stock. We have already seen significant conversions of aging office, industrial, and institutional buildings into housing and redevelopment of functionally or market-obsolete commercial strip centers into a variety of other uses. So the major impact of introducing AVs may be in pressure to repurpose existing auto-oriented buildings and land uses.

For example, there is already pressure to convert parking garages (or parts of parking garages) to housing or commercial/institutional uses, and there are many examples of successful conversions. Many cities have already required that ground-floor frontages (or entire street frontages) be designed for future conversion to non-parking uses.

In the future, this may expand from frontages to requirements that entire floors or structures be designed for conversion to other uses if anticipated declines in parking demand occur. And the private sector may do this on its own (without regulation) when it concludes that local off-street parking demands overstate future needs for that parking.

Additionally, if a significant portion of the AV fleet is operated by shared mobility systems with cars continually circulating for optimum efficiency, the operator will presumably have those vehicles recharge (or fill up) at facilities where land and operating costs are low, which could lead to declining demand for recharging/fueling stations in high-value locations.

As the AV fleet increases and (we are told) they have fewer accidents because they are more than humanly aware of where the other vehicles are, demand for auto body and repair shops could fall. If increased use of AV mobility systems leads to lower per-capita car ownership, we may see declining demand for land to accommodate auto dealerships. In fact, however, the declining demand for this use is already well under way due to online car shopping, storefront showrooms (rather than car lots), and multistory car dealership facilities (to lower land costs). This trend is likely to continue and may only be marginally impacted by the introduction of AVs.

A FEW DISTURBING THOUGHTS

AVs are coming, and the previous discussion should give planners plenty to think about in preparing for their arrival. But

there will probably be some not-so-attractive side effects as AVs are introduced. As we plan for AVs, planners should probably think about mitigating the following unintended side effects:

- Potential loss of jobs. While the AV industry will no doubt create many new jobs, there are four million professional drivers in the U.S. today, and not all of them will keep their jobs.
- Potential health impacts. The only meaningful exercise some Americans get is walking to and from their job to where their car is parked. Front-door drop-offs and pickups will change that.
- Potential marginalization of low-income neighborhoods. Individually owned AVs are more affordable to people with more money, and AV mobility systems are also designed to make money. Without intervention to ensure that mobility systems serve low-income areas, they may choose not to.
- Potential mobile AV-billboard “spam.” What if every system-owned AV has advertising on it, and the software balances driving efficiency with advertising exposure? Not a pretty picture.
- Potential decreases in public transit ridership as some riders opt for an individual (rather than shared) vehicle driven by someone other than themselves.
- Potential pressure for low-density sprawl development at the edges of our cities, if a substantial number of citizens decide that they don’t care how long they spend in the car as long as they’re not driving (which may not be as large a number as some fear).

CONCLUSION

The introduction of AVs will have significant impacts on our built environment, streetscapes, and mobility systems, and we really don’t know the exact order in which those impacts will be felt or their intensity when they arrive. The good news is that, despite the tone of some media coverage, AVs will be introduced over time. For the foreseeable future, we will be living in and regulating cities and counties to accommodate a mixed fleet of AV and non-AV vehicles, which will allow planners time to do what they do best—measure what is changing and design locally appropriate responses to those changes.

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IS YOUR ZONING READY FOR
SELF-DRIVING CARS?

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